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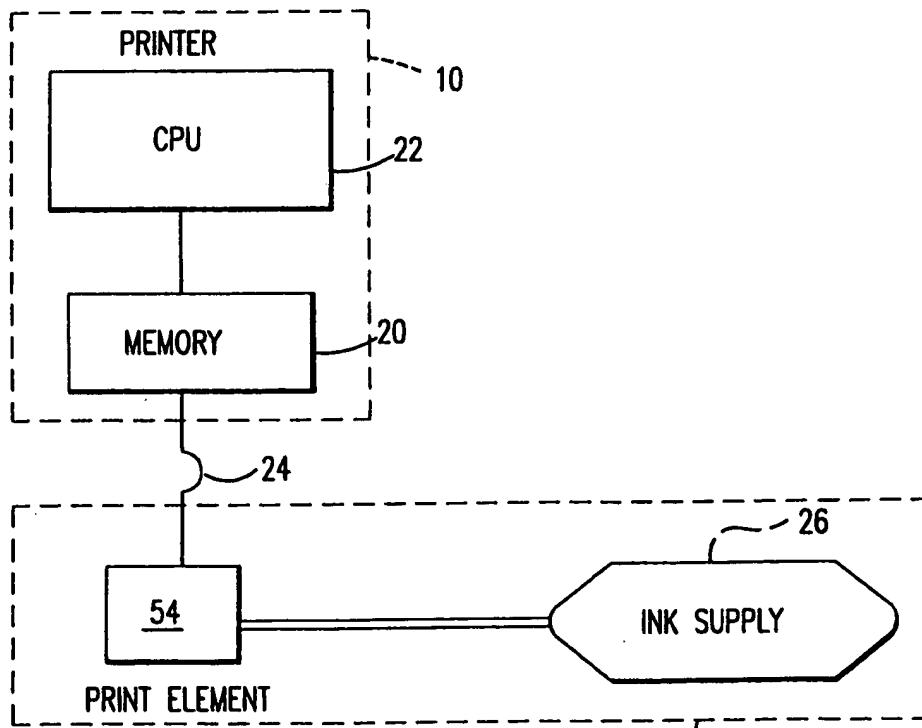
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(54) Ink supply identification system for a printer

(57) A printer (10) having an ink supply identification system includes an ink supply (26), an ink supply identification corresponding to the ink supply, a memory (20) to store the ink supply identification and printer data, a control device (22) for comparing the ink supply identi-

fication to the printer data stored in the memory and for controlling the operation of the printer in response to the ink supply identification, and a print element (54) connected to the ink supply and the control device. The printer has increased reliability that enables a high quality printed image to be produced consistently.



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Description

This invention relates to an ink jet printer, and in particular, to an ink jet printer having means to identify and monitor an ink supply such that the printing function of the printer can be controlled according to the status of the ink supply.

The use of ink jet marking systems in facsimile machines, wide format plotting, special marking applications, and general printing is known. All of these marking applications are subsequently referred to as printing. This invention relates to ink jet printing in general and, more specifically, to thermal ink jet printing.

To ensure high quality and reliable thermal ink jet printing, several variables within the operating environment of the thermal ink jet printer must be controlled. Probably the single most important aspect of ink jet printing relates to the delivery of ink from an ink supply through a print element onto a printing medium. Consistent ink delivery requires that the formulation and chemical composition of the ink be carefully matched to the printhead or print element in order to achieve reliable and predictable performance over time. The ink must be correctly formulated in order to achieve high quality printing. Appropriate ink formulations include; certain necessary additives (often present in small quantities), component chemicals of sufficient purity and sufficient filtration to eliminate particulate matter above a certain size. Characteristics of high quality printing include dark text, lines without ragged edges, the capability to create output in a broad spectrum of colors, the ability to print on a broad range of paper types. Different paper types vary widely according to the process used to make the paper (e.g., an acid-based process), the origin of fibers in the paper (i.e., the species of tree used to make the paper), the sizing level of the paper (i.e., the amount of sizing added to the paper to give it water repellency), as well as other aspects known to the paper making and paper marking arts.

Marking process hard failure modes that can occur when the incorrect ink formulation is used include kogation (i.e., when deposits from the ink are burned on the print element), burned out or damaged print elements, orifices or nozzles plugged with ink particulate, and damage to print elements caused by chemical attack. In addition, ink must be present at the printhead to ensure that the printhead heater elements are not overheated if they are fired without ink being present. For applications in which the printer operates in an unattended mode (e.g., facsimile and plotter applications), the inadvertent depletion of the ink supply results in an inconvenience. In some cases when printing is attempted without ink being present, information is lost and cannot be recovered. Therefore, enabling the printer to detect an "out of ink" condition and to react accordingly would be advantageous.

Ink jet printers in which the print element and the ink supply are combined into a single replaceable "ink

jet cartridge" and ink jet printers in which the print element and the ink supply or ink supplies are severable are both known. This invention relates to both types of printers, but is more specifically directed to printers that

- 5 contain a printhead that can be separated from the ink supply. In this case, because the ink supply can be changed without changing the printhead, the printhead will typically be used with several ink supplies. In either case, the quantity of ink contained within the ink supply
- 10 reflects the printing needs of a typical user, as well as a balance between optimum printer performance (i.e., ensuring that fresh ink is used) and user convenience (i.e., minimizing the frequency of ink supply changes). In addition, the quantity of ink within the ink supply must
- 15 be sufficiently small so that the resulting mass of the ink does not affect the operation of the printer carriage in scanning-type printer configurations. The present invention also applies to an ink supply bag or bottle that is used with a full width array print bar.
- 20 In principle, an empty ink supply container can be refilled and reused in a printer. In practice, the original ink formulations which are contained in such ink supplies are carefully optimized to meet the operating requirements of a specific ink jet printhead and associated marking hardware. The inks often contain a number of proprietary ingredients. Consequently, ink jet printer manufacturers typically sell replacement ink supply containers but not refill kits. Aftermarket or "third party" suppliers, however, often sell refill kits or "clone" ink supply containers. In some cases, third party refill kits contain inks that reduce printer performance and decrease print element life, in part because third parties do not optimize inks for specific applications.

- 35 In addition, as ink jet resolution increases, the fluid passageways within the printhead become smaller and more susceptible to being plugged by ink borne particulate. Sources of particulate contamination include precipitates from the ink, "sludging" or degradation of the container materials and/or the container filling process.
- 40 Therefore, ink filtration and ink supply filling conditions are important considerations in ensuring ink integrity.

- 45 As a result of the continued development of ink jet technology, printing speeds are increasing and ink supplies must be changed more often. In addition, manufacturers now produce permanent and semi-permanent printheads. Therefore, manufacturers seek to maintain these printheads by controlling the quality of the ink supplied to the printhead.

- 50 One approach to controlling the quality of the ink is monitoring the ink supply utilization by identifying each ink supply. Under this approach, ink supplies are encoded with a designation that can be detected or interpreted by a device attached to the printer. Accordingly, the printer can be configured so it can function only if the detected ink supply carries a recognized designation, e.g., a serial number.

From the standpoint of an ink supply or printer manufacturer, an ink supply identification system provides

additional quality control assurances after the time of sale of the printer. In the case of the printer manufacturer, more information about what type and quantity of ink that has been consumed by the printer can be stored and made accessible to the manufacturer's service personnel. If a manufacturer decides that a particular type of ink should not be used in a certain printer model, this model can be configured so as to not recognize the designation for that particular type of ink. Over time, this information will provide the manufacturer with a better basis on which to estimate, e.g., warranty and service costs. Because customers will frequently turn off the power to the printer and unplug it, however, the ink supply information must survive power down cycles. At the same time, the cost of the identification system must be aligned with the cost of the ink supply. In one embodiment, the ink supply container itself is essentially a plastic molded part that can be made for a few cents, so the identification system must be implemented for nearly the same cost.

Within the field of electrostatographic reproducing machines (i.e., photocopiers), a monitor/warranty system for copiers that distinguishes between authorized, authorized but expired, and authorized and unexpired replaceable cartridge units is known, as disclosed in US-A-4,961,088 to Gilliland et al. Each authorized cartridge includes a memory/identification chip in the form of an EEPROM (Electrically Erasable Programmable Read Only Memory) that connects to the copier when the cartridge is installed. The EEPROM logs a count of the number of images copied with that cartridge and disables it when the predetermined maximum number of images is reached. US-A-5,283,594 to Iwao discloses a color copier that detects which color of toner is presently in use by interpreting the magnetic signal emanating from a toner tank of that color.

The copier system, however, cannot be effectively implemented for ink jet printers. Effective tracking of ink usage in ink jet printers must take advantage of the fact that ink jet printing is a digital marking process. The controller in an ink jet printer produces a string of binary commands that trigger individual pixel firing. In order to keep track of the amount of ink that has been used, it is necessary to both count the number of pixels fired and account for ink used in maintenance cycles. Such an approach is not possible in copier applications, because the amount of toner transferred is dependent upon only the integer number of images copied.

Within the field of printers, US-A-4,872,027 to Buskirk et al. discloses a printer having identifiable and interchangeable heads. The printer control changes according to the particular type of head that has been installed as interpreted by the code on the head. Each class of head, e.g., a graphics head or a text head, carries a distinct code. Different codes are interpreted by determining which of several selectively connectable contact pads disposed on the head are connected to the printer. Individual heads belonging to the same class,

however, are not distinguishable.

US-A-5,283,593 to Wehl discloses an ink reservoir that prevents unauthorized refilling. The ink reservoir includes a contact element that, upon being moved to a certain position, triggers the printer to cease functioning. The contact element is moved to this position under the action of a collapsing outer surface of the ink reservoir as ink is consumed. Once the contact element reaches this position, it is held in place by magnetic force, even if a refilling operation that expands the collapsed outer surface of the ink supply is attempted. Accordingly, each ink supply can be used only once.

A primary concern of users today is ensuring reliable printer operation. In addition, users would appreciate a feature by which the printer would signal the impending expiration of the ink supply. Users would also appreciate being prompted with maintenance information at predetermined intervals based upon the volume of ink that has been used. These considerations, as well as those of ensuring high print quality and maintaining printer reliability, can be addressed by providing individually identifiable ink supplies.

At the same time, a manufacturer must be able to guarantee its printer and print element. Such a guarantee can only be offered when some assurance exists about the quality of ink used in the printer. A manufacturer also seeks to ensure reliability of its products and provide a tamper-proof method by which compliance with operating procedures, such as correct ink supply usage, can be assessed.

It is an object of this invention to provide a system by which individual ink supplies can be encoded with a unique designation that can be discerned by a printer. This and other objects are achieved by providing an apparatus and method for identifying individual ink supplies.

In one aspect of the invention, there is provided a printer having an ink supply identification system, said ink supply system comprising: an ink supply, an ink supply identification corresponding to the ink supply, a print element connected to the printer, and a controller resident in the printer. The controller can include a recognition device for recognizing the ink supply identification. The recognition device can recognize a number of different signals, including, e.g., a signal indicating that the ink supply is authorized, a signal indicating that the ink supply is depleted, and a signal indicating that the ink supply is unauthorized. The printer can be configured such that it continues to operate only if a signal indicating that the ink supply is authorized is received.

The signal corresponding to the ink supply identification and recognized by the recognition device can emanate from the ink supply container or the print cartridge. The ink supply identification can be, e.g., a magnetic strip, a nonvolatile electrical device (e.g., an EPROM chip), or a bar code that is affixed to the ink supply container. In this case, the recognition device is either a magnetic strip reader, a communication sequence be-

tween the controller and ink supply component, or a bar code reader, respectively. Alternatively, the ink supply identification can be a string of alpha numeric characters.

The print element and the ink supply container can be disposed together in an ink supply cartridge. The ink supply can also be permanently attached to the cartridge.

The printer and/or the ink supply can also include a memory. The memory can be provided with a number of different nonvolatile registers, including, e.g., spent ink supply, used ink supply, and authorized ink supply registers. The memory can also be used to store a maximum number of firing cycles for a particular print element, in which case the printer also includes an ink quantity detection device for detecting the quantity of ink remaining in the ink supply.

In another aspect of the invention there is provided a method of maintaining the reliability of a printer having an ink supply identification system that includes an ink supply, a print element and control means, the method comprising the steps of: connecting said print element to said printer; and connecting said ink supply to said print element; characterised by: detecting an ink supply identification of said ink supply; and controlling an operation of said printer in accordance with said ink supply identification.

The present invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is an isometric view of a carriage-type thermal ink jet printer;

Fig. 2 is a schematic view of the printer having an ink supply cartridge identification system according to a first embodiment;

Fig. 3 is a schematic view of the printer having an ink supply identification system according to a second embodiment;

Fig. 4 is a flowchart depicting the operation of one embodiment of the present invention;

Fig. 5 is a flowchart depicting the operation of the firing cycle count aspect of the present invention; and

Fig. 6 is a diagram showing a flowchart of the steps performed by the controller in one embodiment superimposed on a schematic view of the ink supply identification system.

Referring to Fig. 1, a thermal ink jet printer 10 is shown. Several ink supply cartridges 2, each having an integrally attached print element 54, are mounted on a reciprocating carriage 6. During the printing mode, the carriage 6 translates back and forth on guide rails 7 as depicted by the arrow 4. A recording medium 8, such as paper, is held stationary while the carriage 6 is moving in one direction. Before the carriage 6 moves in the reverse direction, the recording medium 8 is stepped a dis-

tance equal to the height of the swath of data being printed by the print elements. Each print element 54 has a linear array of nozzles that are aligned in a direction perpendicular to the direction that the carriage is translating. The nozzles face the recording medium and expel ink droplets 9 toward the recording medium.

According to a first embodiment as shown in Fig. 2, the printer 10 is configured to include a nonvolatile memory 20. The contents of the memory 20 remain in storage even if the power to the printer 10 is turned off. The memory 20 is connected to the printer controller (CPU) 22. When the ink supply cartridge 2 is installed, it becomes electrically connected by a series of connections 24 to the printer 10. The connections 24 serve to connect the CPU 22 and memory 20 of the printer 10 to the print element 54 of the ink supply cartridge 2. The connections 24 include a fusible link or other similar programmable device that can be subjected to a current or voltage to permanently alter a signal that can be read through the connection 24. The fusible link can be, e.g., a narrow aluminum strip disposed over a polysilicon heater (not shown) or, alternatively, an EPROM memory location that can be written in only one direction such as from 1 to 0 or 0 to 1. The heater can be energized to fuse the fusible link and in turn sever the electrical connection 24. In the following paragraphs, the term fusible link will be used to refer to the class of devices which can permanently record an electrical event and not be subsequently altered.

In a first embodiment, the ink supply identification system includes a fusible link and an ink supply having a serial number. The ink supply identification system according to this embodiment is inexpensive because the serial number can be a bar code, magnetic strip or other economical method of recording a digital code. Although the description below refers to the configuration in which the serial number is on the ink supply, the description also applies to the configuration in which the ink supply and the print element are consolidated to create a replaceable ink jet cartridge.

Each ink supply 26 is encoded with a unique serial number or one of a large finite set of serial numbers. In the case where there are a finite set of serial numbers and multiple copies of each serial number exist within the ink supply population, a sufficiently large set of serial numbers must be used so that the probability of obtaining the same number twice in one printer is very small compared to other failure modes in the printer.

As shown in Figure 4, when the printer is turned on or at the start of a job (step S90), the printer detects whether the fusible link of the attached ink supply is blown (step S92) and reads the serial number of the ink supply (step S91). Preferably, the fusible link is integrated with other control circuitry functions so that the electrical connection cannot be tampered with or disabled without also making the printer nonfunctional. If the fusible link is blown, the ink supply has been previously used. If the ink supply has been previously used, the

printer compares the ink supply serial number with the serial numbers already stored in memory (step S93). The printer must match the ink supply serial number to an existing serial number within the printer memory in order to enable printing. If no match is found, the printing function is disabled (step S101). If a match is found, the printer checks the remaining ink supply and verifies that ink is left in the supply.

The printer detects the quantity of ink remaining in the ink supply (step S94). If the quantity remaining is less than a predetermined quantity, the operation of the printer ceases (step S103). If the printer determines that the quantity remaining is greater than or equal to the predetermined quantity (step S96), the printer determines whether the quantity remaining is within a predetermined range of the predetermined quantity (i.e., whether the ink supply, although not fully depleted, is close to being fully depleted) (step S98). If the quantity remaining is within the predetermined range, a warning to that effect is displayed (step 102). In either case, printing of the job then begins (step S100).

If the fusible link is not blown, the printer records the first usage of the ink supply by blowing the fuse, reads and records the serial number (step S95), and initializes ink usage recording for that supply (step S99). The printer can optionally check for a blown fuse condition to assure that the first usage is recorded (step S97) before initializing ink usage recording. Periodically, as printing is taking place, the nonvolatile memory that stores the amount of ink is read and updated according to the amount of ink used since the last update. These updates should occur frequently to prevent rounding errors from short jobs. The ink supply identification system allows multiple partially used cartridges to be inserted and removed from a printer, but does not allow two printers to share the same cartridge.

Although the memory 20 in Fig. 2 is shown as part of the printer, the memory 20 can also be configured as a component of the ink supply cartridge 2. The memory 20 can be included in the control circuitry (not shown) within the print element 54 by using, e.g., polysilicon/pyrolytic nitride/tantalum as a floating gate erasable transistor device. Alternatively, a second EPROM device can be disposed in the print element to serve as the memory 20.

An embodiment of the present invention in which the memory 20 is configured as a component of the ink supply 26 is shown in Fig. 6. The print element 54 and the ink supply 26 are shown schematically in relation to the CPU 22 of the printer 10. Although the print element and ink supply are described below as being severable, the dashed line separating the print element 54 from the ink supply 26 indicates that this embodiment applies to applications using an ink jet cartridge as well. During normal printing, data representing the image to be output is transmitted from the CPU 22 to the ink supply cartridge (S901). These data are a series of "1s" and "0s" that indicate whether or not, respectively, an ink jet of

the print element is to be fired to produce a printed pixel at a particular location. At an appropriate interval, a counter is incremented (step S902). In step S903, the count registered in the counter is compared to a predetermined count. The predetermined count is set to a high number of printed pixels according to the particular application, such that the steps described below are executed one or more times during the printing of each page. If the count is less than the predetermined count,

5 the CPU 22 continues to transmit data to the print element 54 and printing continues.

If the count is greater than the predetermined count, the CPU 22 initiates an ink supply write protocol (step S904). In step S904, the CPU 22 sends a code to the

15 ink supply 26 requesting an identification code. On receipt of the code sequence, the CPU evaluates whether the ink supply is authorized. The CPU 22 then communicates that it is writing to the memory 20 in the ink supply 26. In step S905, the controller erases a "1" from the

20 memory 20 to represent that a specified quantity of ink has been depleted from the ink supply 26. The specified quantity of ink is equal to the total capacity of the ink supply 26 divided by the number of "1s" stored in the memory 20. According to this routine, the current volume of ink in the ink supply is decreased according to

25 the number of pixels printed (each pixel being equivalent to one drop of ink) based upon the number of "1s" in the memory.

Fig. 6 also shows the steps performed by the CPU

30 22 in executing a page advance and/or maintenance routine (step S906). The page advance and/or maintenance routine is performed each time the printer is turned on and at the beginning of each job, as well as at other appropriate intervals. In contrast to the steps

35 described directly above, the page advance and/or maintenance routine is preferably executed when the printer is not printing data so as to take advantage of the full computing power of the CPU 22. In step S907, the CPU determines if an ink supply read protocol should

40 be performed by detecting whether the ink supply is authorized. If the ink supply is not authorized, the printer ceases operation. The validation of the ink supply preferably occurs during start up of the printing operation, while validation during the write cycle as outlined above

45 is optional. Similar to the ink supply write protocol described above in connection with step S904, if the CPU 22 recognizes the ink supply 26 as being authorized, the CPU 22 then reads the contents of the memory 20 that represent the quantity of the remaining ink (step S908).

50 Based on the data read from the memory 20, the CPU 22 determines whether the memory 20 contains any "1s" (i.e., whether any ink remains within the ink supply 26) (step S909). If at least a single "1" is present (S909), the CPU 22 determines the exact quantity of ink (step S912), stores this value and enables printing to occur (step 913).

If, on the other hand, at least a single "1" is not present in the memory 20 (step S910), the printer enters

an alternative operating mode (step S911) because the CPU 22 determines that the ink supply is depleted. In the alternative operating mode, the CPU 22 preferably issues a warning to the effect that printing is halted until the current depleted or unauthorized ink supply is replaced.

In addition to detecting whether a fresh ink supply cartridge can be used with the particular printer, the CPU 22 also determines the number of firing cycles that the currently installed ink supply cartridge has completed. In a preferred embodiment, the number of drops or other appropriate measure of consumed ink is rounded off to suit the particular operating requirements. As shown in Fig. 5, after the printing cycle begins (step S80), the CPU 22 periodically updates the firing cycle count (step S82), stores it in the memory 20 (step S84), and compares it to a predetermined maximum firing cycle count (step S86). As the firing cycle count approaches the maximum firing cycle count, the CPU 22 optionally transmits a signal to a display (not shown) or other similar device to signal the user that a fresh ink supply will soon be required. Once the firing cycle count reaches the maximum firing cycle count, the CPU 22 disables the printer (step S88).

According to a second embodiment as shown in Fig. 3, the ink supply 26 is separately detachable from either the print element 54 or the print element 54 and printer 10 combination. In Fig. 3, the print element 54 is included as a removable component of the printer. In this embodiment, the ink supply 26 is encoded with a serial number. The serial number of the ink supply 26 can be encoded, e.g., by (i) affixing a magnetic strip to the ink supply container, (ii) affixing a bar code or other optically recognizable symbol to the ink supply container, or (iii) providing a circuit or chip within the ink supply that establishes an electrical connection with the print element 54 and printer 10 circuitry, etc. In the first and second cases of an ink supply having a magnetic strip or a bar code, the CPU 22 receives a detection signal from a magnetic strip reader or a bar code reader (not shown), respectively, when the ink supply is installed. This embodiment permits the manufacturer to account for the distinct usable lives of the ink supply and the print element. In other words, the CPU can signal the user that the currently installed ink supply has been used up, e.g., used six times, while the currently installed print element has not yet reached the maximum firing cycle count, e.g., the equivalent of firing the ink contained in ten ink supplies.

The ink supply of this embodiment could also be configured to provide the user with an indication of the ink supply fill level. In this case, the CPU 22 compares the current ink supply fill level to a known level stored in the memory 20 to determine whether the ink supply is depleted. The user receives a signal from the CPU 22 that the ink supply is nearly depleted so that a fresh ink supply can be substituted before a new print job is initiated. When a fresh ink supply is installed, the CPU 22

resets the current ink supply level. Additionally, the CPU 22 prevents the user from operating the printer when a spent ink supply has been installed.

In a third embodiment, the additional circuitry re-

- 5 quired to implement either the first or the second embodiment is included in the print element 54, either as an integral part of its circuitry or as separate components. In other words, print elements containing a memory could be retrofitted for conventional print elements
- 10 in conventional printers that use either an ink supply cartridge or a separately connectable ink supply. Installing a print element having the additional circuitry establishes the connection between the CPU 22 of the conventional printer and the print element 54.
- 15 With respect to each of the embodiments, the contents of the memory 20 can be configured in several ways. First, the memory 20 can include a register of the serial numbers for each print element 54 that has been used in the printer 10 (i.e., the "used" register). In this
- 20 case, the CPU 22 compares the detected serial number to the serial numbers in the used register and permits the printer to continue operating only if the detected serial number matches a number within the used register and if the ink supply of the print element is not depleted.
- 25 In this case, the print elements having serial numbers that appear within the used register are considered to be unauthorized when their ink supplies are depleted.

Second, the memory 20 can include a register of authorized numbers (i.e., the "authorized" register).

- 30 Several serial numbers or ranges of serial numbers are prerecorded in the authorized register by the manufacturer. These authorized serial numbers can be the appropriate types of print elements and ink supply cartridges for a particular printer model. In other words, the manufacturer can ensure that an ink supply cartridge that has a normal physical appearance, but that is otherwise unsuitable for the particular printer, will cause the printer to become disabled if the ink supply cartridge is installed. In this way, the manufacturer can take steps to
- 35 avoid damage to the printer and prevent the user from inserting improper ink supply cartridges.

Third, the memory can include a register that contains the serial numbers of print elements that have been used more than a recommended number of times

- 40 (i.e., the "spent" register). Thus, the printer can accept any one of several recognized cartridges that were previously used but not depleted. The spent register contains a counter value for each of the serial numbers contained within a first register. Each time a serial number is detected, the count associated with that serial number is incremented. When the count for a particular print element reaches the recommended number, the CPU 22 transfers the serial number for that print element from the first register to the spent register. A subsequent attempt to use the print element disables the printer.

The various ways of configuring the memory can be combined. For instance, the memory may include both an authorized register and a used register. Furthermore,

although the preceding discussion refers to serial numbers, it is understood that this term encompasses whatever unique indicia is used to designate each independent ink supply cartridge or ink supply.

Claims

1. A printer (10) having an ink supply identification system, said ink supply system comprising:

an ink supply (26);
an ink supply identification corresponding to said ink supply;
a print element (54) connected to said ink supply and said printer; and
control means (22) for controlling an operation of said printer in response to said ink supply identification, characterised by:
said control means including recognition means for recognizing said ink supply identification of said ink supply and for transmitting a signal corresponding to said ink supply identification.

2. The printer of claim 1, wherein said recognition means recognizes one of a plurality of signals from said ink supply;

wherein one of said plurality of signals indicates that said ink supply is authorized or unauthorised; and
wherein one of said plurality of signals indicates that said ink supply is depleted.

3. The printer of claims 1 or 2, wherein said control means permits the operation of said printer to continue only if said control means receives a signal indicating that said ink supply is authorized.

4. The printer of any of the preceding claims, wherein said recognition means includes ink quantity detection means for detecting a quantity of ink remaining in said ink supply.

5. The printer of claim 4, further comprising a memory (20) connected to said control means, wherein said ink quantity detection means detects said quantity of ink remaining in said ink supply by comparing a number of firing cycles completed by said print element of said printer with a predetermined maximum number of firing cycles.

6. The printer of claim 1, wherein said ink supply identification is a magnetically encoded strip and said recognition means is a strip reader for reading said magnetically encoded strip.

7. The printer of any of the preceding claims, wherein said ink supply (26) and said print element (54) are disposed within a print cartridge (2) and said print cartridge is removably insertible into said printer (10).

8. The printer of claim 7, wherein said ink supply is permanently attached to said print cartridge (2) such that a user cannot remove said ink supply from said print cartridge.

9. The printer of claim 1, further comprising a memory connected to said control means, said memory containing said ink supply identification; and wherein said memory includes a used ink supply register, said used ink supply register containing at least one used ink supply identification corresponding to an ink supply that has been at least partially depleted by said printer, a spent ink supply register, said spent ink supply register containing at least one spent ink supply identification corresponding to an ink supply that has been depleted by said printer, or an authorized ink supply register, said authorized ink supply register containing at least one authorized ink supply identification corresponding to an authorized ink supply, wherein said authorized ink supply is suited for use in said printer.

10. A method of maintaining the reliability of a printer (10) having an ink supply identification system that includes an ink supply (26), a print element (54), and control means (22), the method comprising the steps of:

connecting said print element to said printer;
and
connecting said ink supply to said print element; characterised by:
detecting an ink supply identification of said ink supply; and
controlling an operation of said printer in accordance with said ink supply identification.

11. The method of claim 10, wherein said printer further comprises providing a memory (20), and wherein said step of controlling includes comparing a detected ink supply identification with at least one said ink supply identification stored in said memory.

12. The method of claims 10 or 11, further characterised by continuing an operation of said printer if said detected ink supply identification matches said ink supply identification, or discontinuing an operation of said printer if said detected ink supply identification does not match said ink supply identification.

13. The method of any one of claims 10 to 12, wherein said step of controlling includes logging a number

of completed firing cycles corresponding to a number of drops expelled by said print element; updating said number of completed firing cycles; comparing said number of completed firing cycles to a predetermined maximum number of firing cycles; and disabling said printer when said number of completed firing cycles reaches said maximum number of maximum firing cycles.

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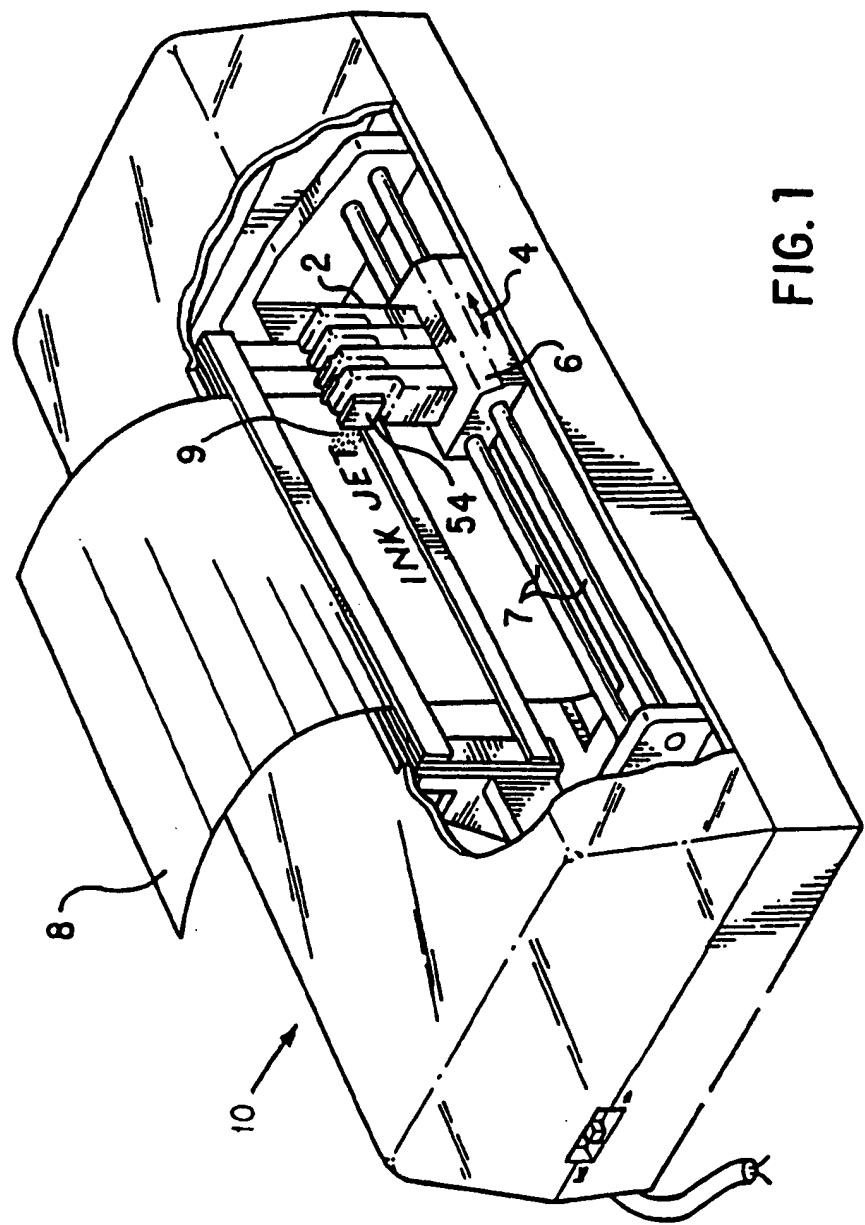
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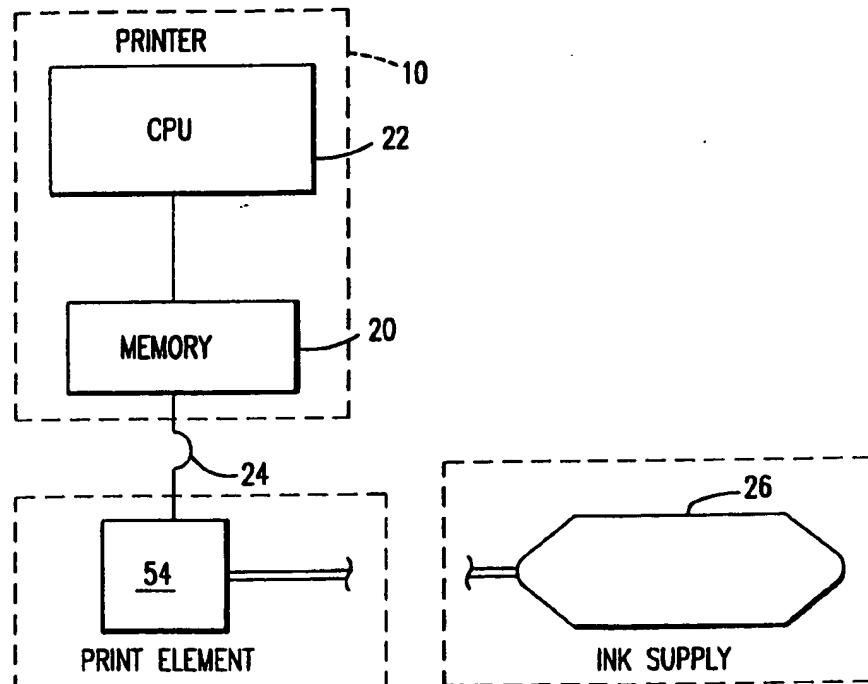
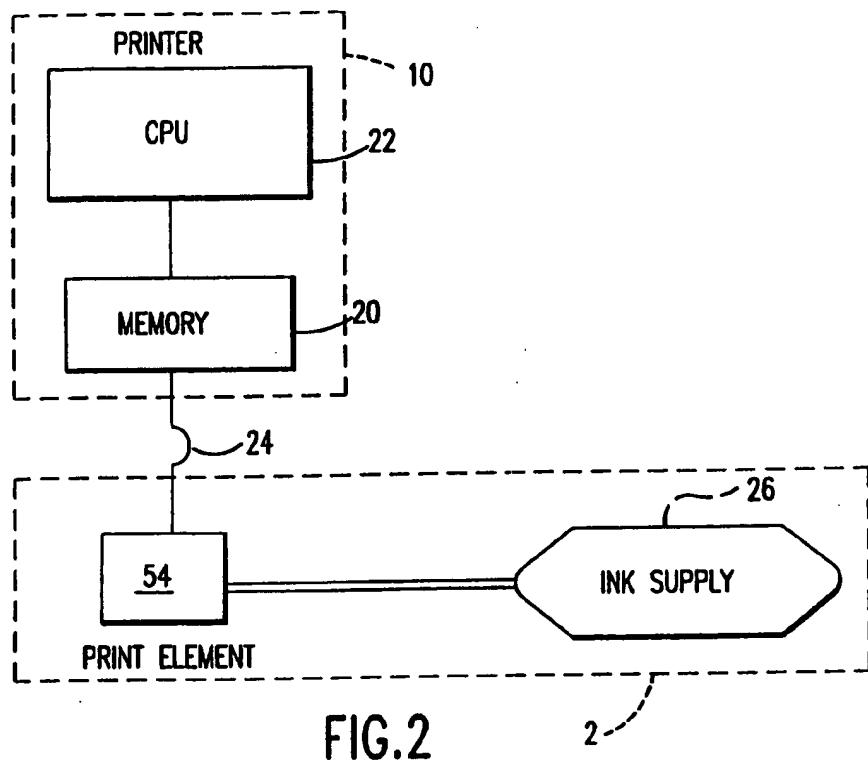
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FIG. 1



**FIG. 3**

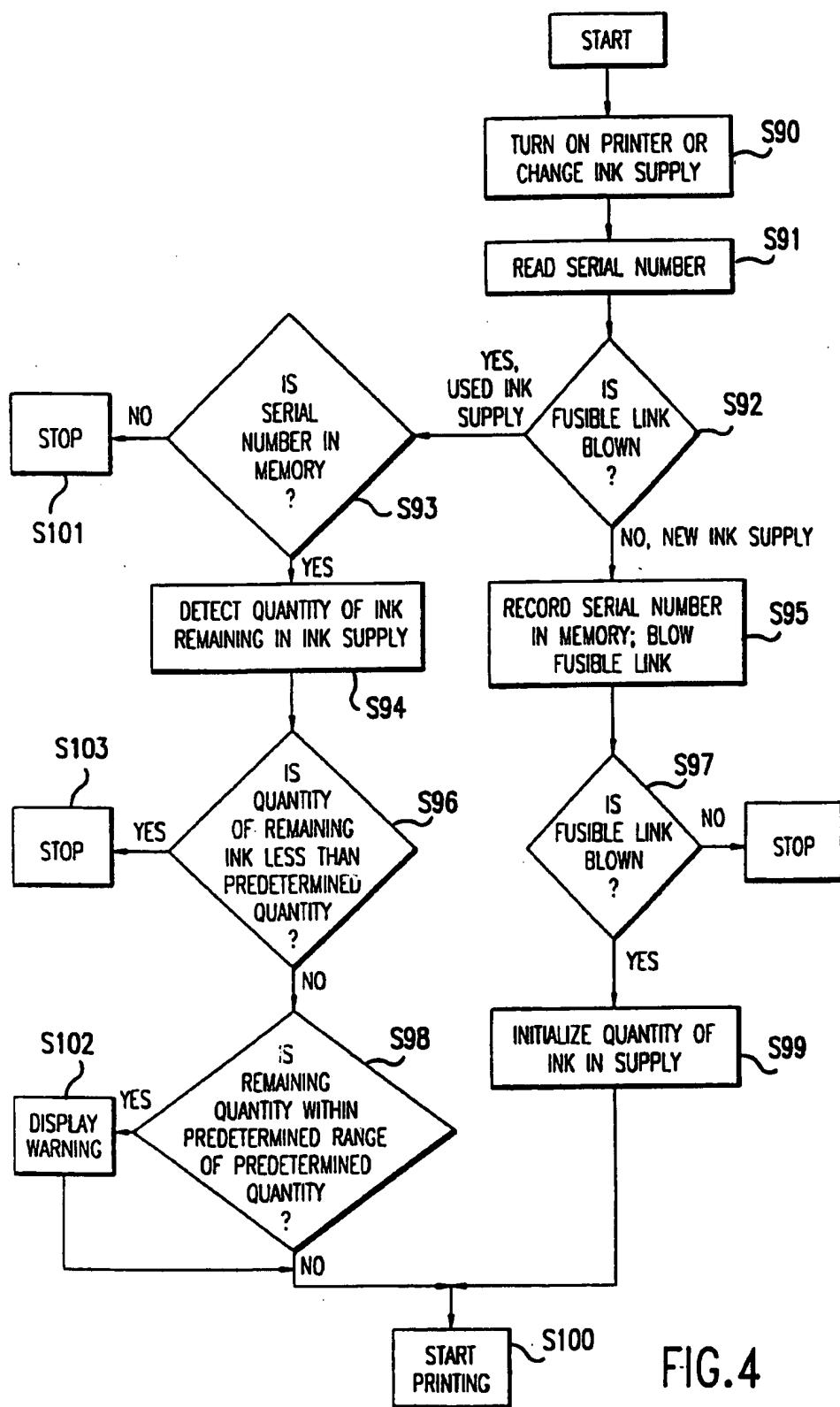


FIG.4

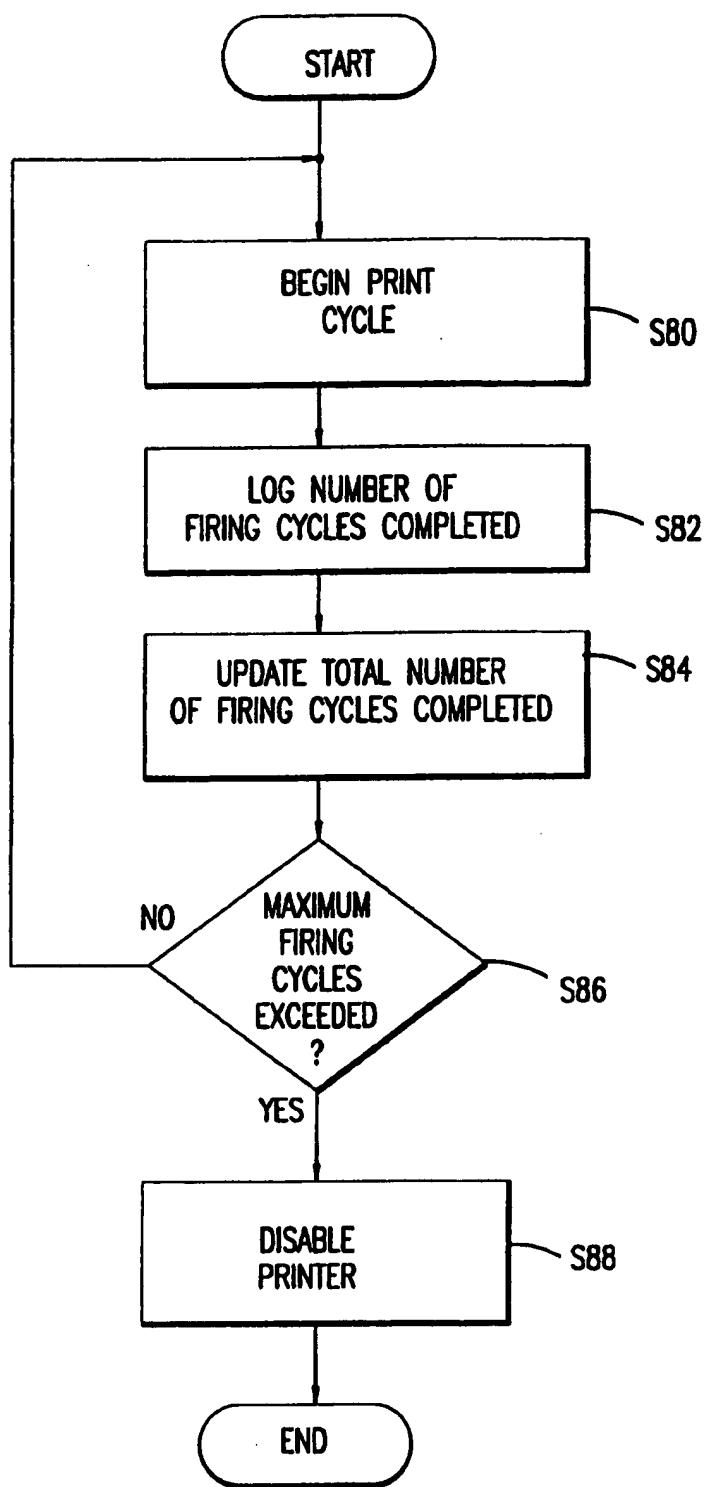


FIG.5

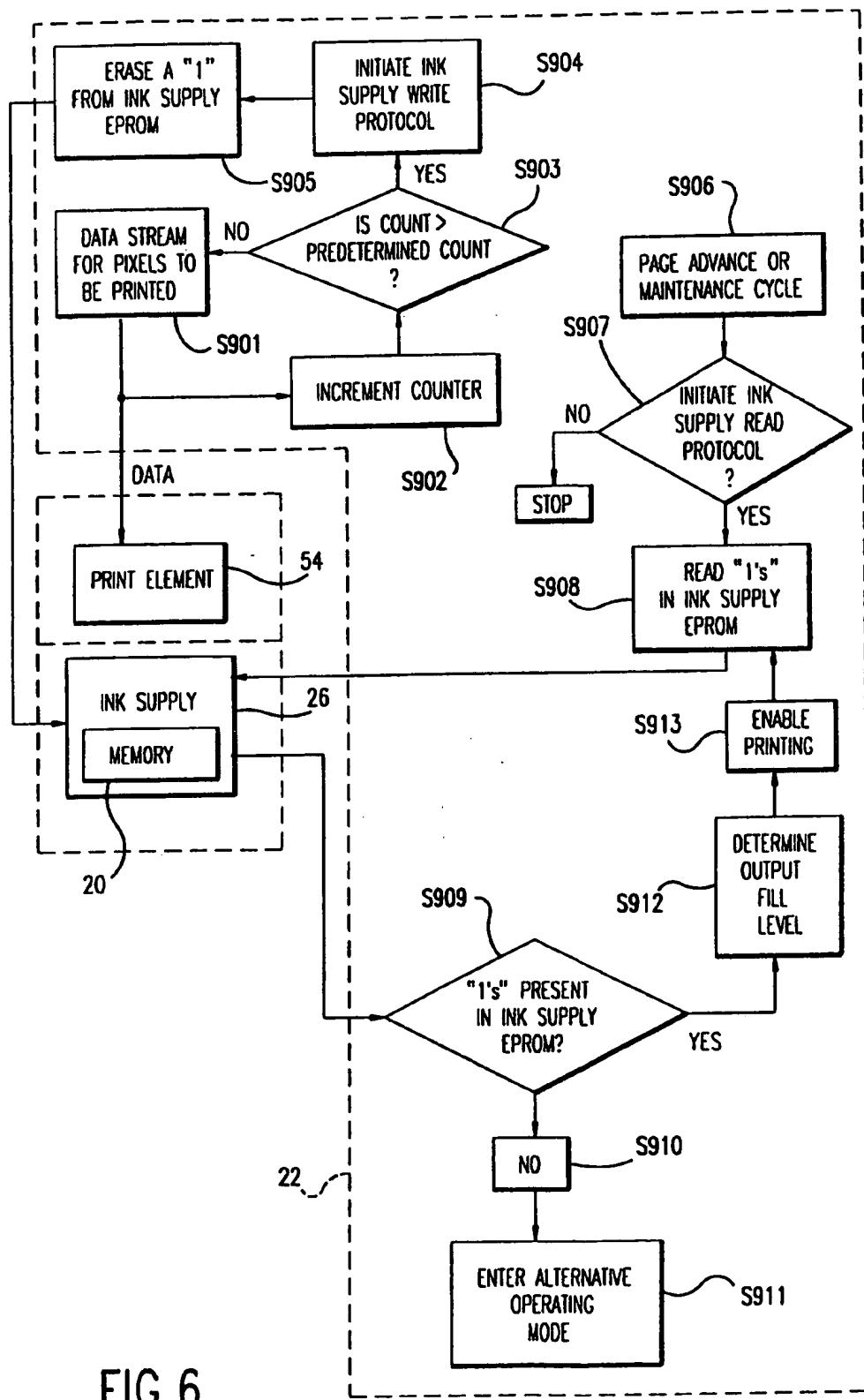


FIG.6

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